

reference numeral “4” which appears in the drawings of FIG. 1. In fact, the drawing of FIG. 1 was mis-labeled, and the component designated as “4” (reference to a MEMS mirror element) should have been labeled as “11”.. Applicants are including a corrected Formal Drawing with this response.

Objection to the Claims

The Examiner next objected to claim 3 with respect to the phrase “according to claim 2 wherein 1 wherein”, citing the language as ambiguous. In response, applicants have amended claim 3 to simply depend from independent claim 1. It is believed that this amendment is more than sufficient to overcome the Examiner’s objection to claim 3. Claims 1, 12 and 13 were next objected to by the Examiner for “improper wording”. The phrase “in via holes” was cited by the Examiner as not corresponding “to the accepted meaning of the words”. Applicants must disagree with the Examiner on this point. “Via holes” is a term of art, prevalent in semiconductor processing technology, that defines the formation of columnar apertures (“holes”) through the thickness of a layer of material. In most cases, via holes are conductive and used to provide an electrical connection from a first set of conductive paths on one side of a substrate to conductive paths on the opposite side of the substrate. The term “via hole” is used precisely in this fashion throughout applicants’ specification. The Examiner is directed, for example, to the specification at page 3, lines 27 and 30. In light of this discussion, applicants respectfully request the Examiner to reconsider this objection and find claims 1, 12 and 13 to be clear in their choice of wording.

Lastly, the Examiner cited claims 11 and 12 as ambiguous with respect to the recitation of “a member” or “a mirror”. In response, applicants have amended these claims to specifically refer to “a member of the array” or a “mirror of the array”, defining the single element as belonging to the previously-defined array. With these amendments, applicants believe that claims 11 and 12 are no longer ambiguous and respectfully request the Examiner to reconsider this objection.

35 USC 103(a) Rejection – Claims 1, 2, 4, 11, 13, 14 and 17

The Examiner first rejected claims 1, 2, 4, 11, 13, 14 and 17 under 35 USC 103(a) as being unpatentable over US Patent 6,433,411 (Degani) in view of JP Patent 09261975 (Higuchi). The Examiner cited Degani as teaching “an array ... of electrostatically activated members ... formed on a layer comprising silicon”. Degani was further cited by the Examiner as teaching “a substrate comprising a ceramic material ... including conductors formed on a major surface”. The Higuchi reference was then cited by the Examiner as teaching “the use of via holes (3) through a substrate (1) to selectively operate an array of members”. The Examiner then concluded that “it would have been obvious to a person of ordinary skill in the art at the time the invention was made to use the through hole electrostatic actuator taught by Higuchi in the Degani invention for the purpose of creating a more electrically isolated environment around the micromirrors”.

In response, applicants assert that the combination of Degani and Higuchi cannot be found to disclose or suggest the inventive device as defined by independent claims 1 and 13 (or the other cited dependent claims). There is no teaching in Degani of utilizing “a substrate comprising a ceramic material” as the support substrate for all of the electrical connections for controlling an array of electrostatically activated members. Rejected claim 1 defines a ceramic substrate that includes “conductors” that are “positioned to selectively operate the array of members”. The Examiner is referred to FIG. 1 of Degani, which illustrates an exemplary MEMS array, formed on a silicon substrate 12, *including* the drive electrodes 15-18 (see column 3, beginning at line 1). Thus, Degani illustrates precisely the prior art structure that is supplanted by the arrangement of the present invention, which functions to separate the optical components and electrical components onto separate elements (the MEMS devices formed in a silicon array and the conductors formed on a ceramic substrate). The ceramic structure of Degani, as shown in FIG. 3, is an “interconnect substrate” (see column 5, line 9 *et seq.*), used to mechanically separate the MEMS device (including the electrical conductors) from the external signal source used to control the operation of the various MEMS elements. Ceramic interconnect substrate 52 of Degani does not include “conductors” that are “positioned so as to selectively operate the array of [electrostatically activated] members”, as defined by rejected device claim 1. Additionally, the ceramic interconnect

substrate of Degani cannot be found to render obvious the “mounting” step of independent claim 13, which requires “mounting said silicon layer over a substrate comprising a ceramic material which includes conductors formed on a major surface of the substrate”.

The ceramic substrate of Degani does, contrary to the Examiner’s assertion, include conductive via holes (see element 59 in FIG. 3 of Degani). However, the top surface of ceramic substrate 52 of Degani does not further include the conductors necessary to control the action of the MEMS devices – these conductors are directly formed on silicon substrate 12 with the actual MEMS devices.

Since Degani cannot be found to disclose or suggest the use of a separate ceramic substrate to form the control conductors for a MEMS device/array, applicants assert that the combination of Degani and Higuchi cannot be found to render obvious the teaching of the present invention as defined by independent claims 1 and 13, as well as cited dependent claims 2, 4, 11, 14 and 17. Applicants therefore respectfully request the Examiner to reconsider this rejection and find the cited claims to be in condition for allowance.

35 USC § 103(a) Rejection – Claim 3

The Examiner next rejected claim 3 under 35 USC 103(a) as being unpatentable over Degani in view of Higuchi (as applied to claim 2, above), in further view of an article entitled “*Free-Space Micromachined Optical Switches for Optical Networking*” (Lin). The Lin reference was used by the Examiner specifically cite the formation of a “bigger” MEMS array (an 8x10 array). Regardless of the teaching of Lin, applicants assert that the combination still lacks any teaching regarding the use of a first element (a silicon layer) to form the actual MEMS array and a second element (a ceramic substrate) to form the electronics for controlling the MEMS array. Without this teaching, applicants assert that the cited combination cannot be found to render obvious the teaching of claim 3, which ultimately depends from claim 1 (discussed above). Applicants therefore respectfully request the Examiner to reconsider this rejection and find claim 3 to be in condition for allowance.

35 USC § 103(a) Rejection – Claim 5

Claim 5 was next rejected by the Examiner under 35 USC 103(a) as being unpatentable over Degani and Higuchi (as above, applied to claim 1), in further view of US Patent 6,393,187 (Engleberth). The Engleberth reference was cited by the Examiner as teaching the use of a metal layer deposited on a silicon layer. However, the Engleberth reference is not germane to the subject matter of MEMS technology, but to an optical fiber-based free space optical switch. Regardless of the subject matter of Engleberth, however, it is asserted that the combination of Engleberth with Degani and Higuchi still lack any teaching of using a separate silicon layer and ceramic substrate, as defined by claim 5 (based on independent claim 1). Applicants therefore respectfully request the Examiner to reconsider this rejection and find claim 5 to be in condition for allowance.

35 USC § 103(a) Rejection – Claims 7 and 9

Claims 7 and 9 were next rejected by the Examiner under 35 USC 103(a) as being unpatentable over Degani in view of Higuchi (as applied to claim 1), in further view of the article “*Thin Film Metallization for Aluminum Nitride*” (Imanaka). Imanaka is cited for its teaching of the properties of a ceramic material (in particular, for the use of aluminum nitride and issues regarding its roughness). However, the combination of Imanaka with Degani and Higuchi still lacks any teaching of using separate silicon and ceramic members for the optic and electronic portions of a MEMS device, as defined by independent claim 1, from which both claims 7 and 9 depend. Applicants thus respectfully request the Examiner to reconsider this rejection and find claims 7 and 9 to be in condition for allowance.

35 USC § 103(a) Rejection – Claim 8

The Examiner next rejected claim 8 under 35 USC 103(a) as being unpatentable over Degani in view of Higuchi (as applied to claim 1), in further view of Lin (as above). The Examiner particularly cited Lin as teaching the use of a substrate with a flatness less than 10 microns (particularly, Lin teachings a flatness of 0.5 microns). Regardless of the teaching of Lin, applicants assert that the combination still lacks any teaching regarding the use of a first element (a silicon layer) to form the actual MEMS array and a second

element (a ceramic substrate) to form the electronics for controlling the MEMS array. Without this teaching, applicants assert that the cited combination cannot be found to render obvious the teaching of claim 8, which ultimately depends from claim 1 (discussed above). Applicants therefore respectfully request the Examiner to reconsider this rejection and find claim 8 to be in condition for allowance.

35 USC § 103(a) Rejection – Claim 10

The Examiner next rejected claim 10 under 35 USC 103(a) as being unpatentable over Degani in view of Higuchi (as applied to claim 1), in further view of US Patent 6,329,607 (Fjelstad) and US Patent 6,284,656 (Farrar). The Fjelstad and Farrar references were cited by the Examiner as teaching particular line width and spacing requirements for conductors in microelectronic structures. However, this combination still lacks any teaching of utilizing separate substrates for MEMS devices and their associated conductors, as required by rejected independent claim 1, from which claim 10 depends. Applicants thus respectfully request the Examiner to reconsider this rejection and find claim 10 to be in condition for allowance.

35 USC § 103(a) Rejection – Claim 12

Independent claim 12 was rejected by the Examiner under 35 USC § 103(a) as being unpatentable over Degani, in view of Higuchi, Lin and Imanaka, for all of the reasons discussed above in association with the rejection of the previous claims. In light of the lack of teaching in Degani regarding the use of a ceramic substrate to provide and support the “conductors” that are “positioned so as to selectively operate the array of mirrors” as defined by claim 12, applicants assert that this combination of references cannot be found to render obvious the subject matter of claim 12. It is therefore respectfully requested that the Examiner reconsider this rejection and find claim 12 to be allowable over the cited combination.

35 USC § 103(a) Rejection – Claims 15 and 16

Lastly, the Examiner rejected claims 15 and 16 under 35 USC 103(a) as being unpatentable over Degani in view of Higuchi (as applied to claim 13, above), in further

view of US Patent 5,995,688 (Aksyuk). The Aksyuk reference was cited by the Examiner as teaching bonding of a MEMS substrate to a SiOB substrate. However, there is no teaching in Aksyuk of bonding a silicon layer (supporting MEMS devices) to a *ceramic* substrate supporting MEMS electronics. Applicants thus assert that the combination of Aksyuk with Degani and Higuchi cannot be found to render obvious the subject matter of the present invention as defined by claims 15 and 16.

Applicants believe that with the above-cited amendments to both the claims and the drawings, the application, in its present form, is in condition for allowance. Applicants thus respectfully request the Examiner to reconsider the objections and rejections, and find claims 1-17 ready to issue. If for some reason or other the Examiner does not agree that the case is ready to issue and that an interview or telephone conversation would further the prosecution, the Examiner is requested to contact applicants' attorney at the telephone number listed below.

Respectfully submitted,

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Bracketed and Underlined Claim Amendments for App. No. 09/872,306

Please **amend claims 1-17** as follows:

1. *(Amended)* A device comprising:
 an array of electrostatically activated members formed in a layer comprising silicon; and
 a substrate comprising a ceramic material and including conductors formed on a major surface thereof [the substrate] and in via holes formed therethrough [in the substrate], the conductors being positioned with respect to the silicon layer so as to selectively operate the array of members.

3. *(Amended)* The device according to claim [2 wherein] 1 wherein the array comprises a structure of [is] at least [8x10] eight members by at least ten members.

11. *(Amended)* The device according to claim 1 wherein the conductors positioned to operate [a] one member from the array of electrostatically activated members comprise an array of at least four conductors extending through separate via holes.

12. *(Amended)* A device comprising:
 an array of least 8x10 mirrors rotatable about at least two axes formed in a layer comprising silicon;
 a spacer layer formed over a surface of the silicon layer; and
 a substrate comprising a ceramic material comprising AlN having flatness of less than or equal to 10 microns and a surface roughness of less than or equal to 1 micron, said substrate including conductors formed on a major surface thereof [the substrate] and in via holes formed therethrough [in the substrate], the conductors being positioned with respect to the silicon layer so as to selectively operate the array of mirrors, wherein the conductors positioned to operate a mirror comprise an array of at least four conductors extending through separate via holes.